

THE STRUCTURAL FEATURES OF THE BRYOZOAN GENUS
HOMOTRYPA, WITH DESCRIPTIONS OF SPECIES FROM
THE CININNATIAN GROUP.

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In 1882^a Mr. E. O. Ulrich established the genus *Homotrypa* for a group of species typified by *H. curvata*, a common and characteristic fossil of the lower Lorraine at Cincinnati, Ohio, and vicinity. In that paper two species were described—the one just mentioned and *H. obliqua*. In subsequent papers this author added twelve species and varieties. Other authors have described four species which have been referred to the genus. In the course of their collecting Messrs. Ulrich and Nickles and the writer have discovered a large number of forms belonging to this genus, which will eventually include not less than fifty species. With so great a specific representation *Homotrypa* may well rank as the most important genus, not only of the *Monticuliporidae*, but also of the order *Trepostomata*. Moreover, the genus is interesting from both the geologic and biologic standpoints; geologically, because most of the species are common fossils, usually of restricted vertical distribution and thus are good horizon markers; biologically, because many species exhibit remarkably well certain structures which indicate the bryozoan nature of the monticuliporoids. It is the purpose of this paper to point out and describe these structures as studied from thin sections, and to define and tabulate the species found in the Cincinnati group.

The number of species of trepostomatous bryozoa is so large and their external characters often so similar that it appears a hopeless task to identify them without thin sections, yet it is a mistake to think that thin sections are always necessary. Sections are desirable, but are a necessity only when the internal characters of a new species are being studied. The structures shown in tangential sections are often

^aJour. Cincinnati Soc. Nat. Hist., V, 1882, p. 240.

nicely brought out by smoothing the surface of the zoarium with the edge of a knife blade or rubbing upon a gritty stone, and after etching slightly with acid examining with a lens the spot thus treated, moistening it slightly. Similarly, vertical fractures when treated in the same way show the characters seen in vertical sections. By this ready method it is seldom difficult to recognize a *Homotrypa* as the cystiphragms in the peripheral region are easily detected, if not in the tangential, then certainly in the vertical section. Except in the matter of size, the surface characters of the zoecia are seldom distinctive of any species of *Homotrypa* and are more or less similar in all the species. For that reason, only the zoarium and internal characters of the species here described are figured and only when the surface characters are out of the ordinary are they described. To obtain the number of zoecia in a given space a measurement is made from the center of one macula to the center of one adjoining. The average of several such measurements gives the correct number, which may be verified by counting the number of zoecial tubes in the same space in the peripheral region of vertical sections.

HOMOTRYPA Ulrich.

Homotrypa ULRICH, Jour. Cincinnati Soc. Nat. Hist., V, 1882, p. 240; Geol. Sur. Illinois, VIII, 1890, pp. 370, 409; Geol. Minnesota, III, 1893, p. 235; Zittel's Textb. Pal. (Engl. ed.), 1896, p. 273.—FOORD, Contr. Micro.-Pal. Cambro.-Sil., 1883, p. 9.—MILLER, North American Geol. Pal., 1889, p. 309.—NICKLES and BASSLER, Bull. U. S. Geol. Survey, No. 173, 1900, p. 29.

The genus has been briefly defined as follows:

Zoarium frondescent or ramose; maculae or monticules of larger cell apertures a characteristic feature; apertures often oblique; zoecia with very thin or finely crenulated walls and remote diaphragms in immature region and cystiphragms, isolated or in series, confined to mature region; mesopores few, in clusters; acanthopores generally developed.^a

The essential generic characters are the upright zoarium, the presence of cystiphragms in the peripheral region only, and the development of few mesopores. The form of the zoarium, the shape and size of the maculae and zoecia, and the number of the latter in a given space, thickness of zoecial walls, distribution of diaphragms and cystiphragms, and the number, size, and distribution of acanthopores and mesopores are the important variable quantities upon which the specific characters are based.

The species of *Homotrypa* may be classed into two well-defined groups, the presence or absence of diaphragms in the peripheral region of the zoecial tubes being the distinguishing characteristic. In the typical section, which may be designated the *H. curvata* group,

^aNickles and Bassler, Bull. U. S. Geol. Survey, No. 173, 1900, p. 29.

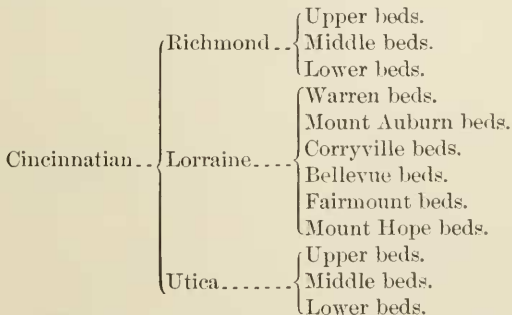
diaphragms as well as cystiphragms are present in the peripheral region. The Warren^a beds of the Lorraine formation show the advent of a group of species in which diaphragms are seldom, if ever, shown in sections either in the axial or peripheral region of the zoecial tubes. *H. communis*, an abundant Richmond species, may be considered the type of the group, and a glance over the appended table of species will show that this section will include *H. bassleri* and *H. libana* from the Lorraine, and *H. darwoni*, *H. communis*, *H. nodulosa*, *H. austini*, *H. cylindrica*, and *H. richmondensis* from the various divisions of the Richmond. Whether the diaphragms were membraneous and not capable of preservation, or whether they were not developed at all, can not be determined. Associated species of the genus show diaphragms well developed in either the peripheral or in both regions, and this fact would seem to indicate that their absence in this group is of structural importance. A subdivision of the *H. communis* group is suggested under the discussion of the cystiphragm.

The typical section of the genus, the *H. curvata* group, includes all of the described species and the new forms of this paper with the exception of those mentioned above. It is by far the more important group, and ranges through the Mohawkian and Cincinnati groups, while the *H. communis* section is confined to the upper Lorraine and Richmond.

THE CYSTIPHRAGM.

The peculiar structures which were termed cystiphragms by Ulrich are well developed in *Homotrypa* and constitute a generic feature. These cystiphragms, or cystoid diaphragms as formerly termed, occupy

^aThe subdivisions of the Cincinnati group recognized in this paper are those published by Nickles (Jour. Cincinnati Soc. Nat. Hist., XX, 1902, pp. 49-100). For convenience of reference the classification is here repeated.



The Richmond strata exposed in Illinois, Wisconsin, Minnesota, and Manitoba, and termed the northwestern Richmond in the appended tables, are here correlated with the Upper beds of Nickles's classification.

generally one side of the zoöcial cavity as a series of superimposed vesicles. When tangential sections cut these vesicles, they show within and extending across the zoöcial cavity, a curved line, the amount of curvature depending upon the gibbosity of the cystiphragm. In *H. callosa* Ulrich, and *H. ramulosa* (see Plate XXV, fig. 3) this line is but slightly curved, showing that the vesicle was little rounded. In the type species the vesicle is of such a shape and occupies so much space as to cause the cut edge shown in tangential sections to extend around about two-thirds of the circumference of the zoöcial chamber. A different style of cystiphragm occurs in such species as *H. pulchra* and *H. cincinnatiensis*. Here, occasionally, the cystiphragm extends entirely around the bounding wall but leaves the central portion of the zoöcial cavity unoccupied, and here ordinary horizontal diaphragms are developed. In this case, tangential sections (Plate XX, fig. 12, Plate XXI, fig. 7) show the cystiphragm as a more or less rounded, central ring. In vertical sections the cystiphragms appear as semicircular lines lining usually one side of the zoöcial tube, but when the vesicles extend entirely around the cell cavity both sides show a series of curved lines.

The portion of the peripheral region of the zoöcial tube not occupied by the cystiphragms is generally intersected by transverse partitions, the diaphragms, which may or may not be as numerous as the cystiphragms, seldom however exceeding them in number. It is also to be noticed that in forms showing no diaphragms in the zoöcial tubes the cystiphragms seldom overlap, the lower end of one not reaching to the next below. If this interpretation is true to nature it would imply that the cystiphragms were open at the bottom. However, one or both of the following explanations may account for this appearance. The cystiphragms are seen in vertical sections to be thickest at the upper end, and often are reduced in thickness to extreme thinness at the point of overlap. In the forms under discussion the lower part of the cystiphragm may have been so thin that sections do not reveal it at all. Another interpretation is that suggested by Nickles in the description of *H. bassleri*, that calcification in the living state was more or less incomplete.

Upon the basis of the distribution of the cystiphragms the *H. communis* group of the genus may be further subdivided into two sections, one in which cystiphragms line the peripheral region of all the zoöcia; and another in which the zoöcial tubes of the maculae only are provided with cystiphragms, as seen in sections of *H. austini*. The latter, an unusual occurrence, may throw some light upon the functions of both maculae and cystiphragms. Ulrich has considered the maculae (including the monticules and groups of larger zoöcia, all of which are evidently identical in function) of trepostomatous bryozoa to be connected in some way with reproduction, these groups perhaps

being set aside for that purpose. In *Cerriocara ramosa* of the Cretaceous (see Plate XX, figs. 5, 6), ovarian-like vesicles, very similar to cystiphragms, have been found, and this fact leads to the belief that the cystiphragm also had a reproductive function. Hence the restriction of these structures in this species to the zoecial tubes of the maculae only may have some significance.

THE ACANTHOPORE.

The majority of the species of *Homotrypa* exhibit these spine-like structures—the acanthopores. The ordinary acanthopore when showing at the surface is seen to be a blunt spine situated on the cell wall, usually at the angle of junction of adjoining zoecia.

Tangential sections show that this spine is composed of concentric rings of laminated tissue inclosing a minute, round canal. A vertical section brings out the fact that the spine is not a mere surface ornament, but that it is a tube inclosed in the wall substance of the zoecium; that this tube is developed generally with the mature region and continues as an independent structure to the surface. In some species they are well developed and here exhibit their structure most clearly. The acanthopores of *H. nodulosa* and *H. cylindrica* of this paper show all that has been learned concerning these structures. That of *H. nodulosa* viewed in a tangential section (Plate XXIII, fig. 7) differs from the ordinary form in having a comparatively large central space, the diameter of this sometimes being as much as one-half that of the entire structure. A vertical section (Plate XXIII, figs. 5, 6) shows clearly that the acanthopore is not only a tube, but that this tube is also crossed by thin transverse partitions about the tube diameter distant from each other. Such a section also shows that instead of being limited to the mature region, the acanthopore may develop in any part of the immature region, pass through in turn both this and the mature region, and then, instead of stopping with the zoarial growth to which it belongs, continue through the immature and mature regions of an incrusting, secondary growth of the species if this be present. This section also shows that the concentric rings seen in tangential sections surrounding the central space are the cut edges of overlapping, conical layers of tissue forming the wall of the tube. The acanthopore of *H. cylindrica* (Plate XXII, fig. 10) is interesting because it shows to how great an extent these conical layers may be developed and, in contrast with preceding species, how minute the central cavity may be. Yet even in this species, in which the diameter of the tube is generally less than one-twentieth that of the entire acanthopore, the transverse partitions may be seen under favorable circumstances.

Possessing such structure, it must be conceded that the acanthopores were of no little importance to the zoarium. Just what their function

was is not known, but, as suggested by Ulrich, they may have supported appendages similar to the avicularia or vibracula of recent bryozoa. They certainly are not, as considered by Waagen and Wentzel,^a mere thickenings preceding gemmation. Nor do they give rise to mesopores, which in turn develop into true zoëcia as schematically illustrated by these authors. In actual sections such a development is not known, and among the thousands of thin sections of trepostomatous bryozoa examined by the writer, not one has been seen that in anywise countenanced their interpretation. The zoëcia, mesopores, and acanthopores of these fossil forms are as distinct and independent structures as are the polypides, avicularia, and vibracula of recent chlostromatous bryozoa, whose wholly distinct morphological development has been demonstrated by students of living species.

COMMUNICATION PORES AND INTERMURAL STRUCTURE.

Under certain conditions tangential sections indicate that the zoëcial walls and the intermural space are seemingly pierced by communication pores or connecting foramina. These were first recorded by Ulrich in the descriptions of *H. curvata* and *H. obliqua*. Dr. Rominger, in a critical paper,^b subsequently denied the presence of these pores. I have figured tangential sections of *H. wortheni* and *H. nodulosa* (Plate XXIV, fig. 12; Plate XXV, fig. 15) which show that such structures do exist in *Homotrypa* and are found in other species than those mentioned by Ulrich. Indeed, they have been found in so many species of this genus that their presence may be considered a generic feature. These pores are best observed when the section is rather thick. As the section is thinned the pores become less distinct, and when very thin disappear altogether. This is because the denser tissue of the zoëcial walls in thick sections brings out into relief the clearer substance of the connecting foramina, but as the section is thinned the substance of the walls becomes more and more translucent until, finally, both wall and pore are alike in clearness and the outline of the latter is lost.

Thin sections show that each zoëcium has its own bounding wall distinct from adjacent zoëcia, the space between, which is here termed the intermural space, being occupied by the acanthopores and a dotted or granular layer, which in sections has a structure very similar to that exhibited by the parenchymal chord of more recent bryozoa (see Plate XX, fig. 2). The width of this intermural space varies with the species and with the age of the zoëcia. Sometimes, even in the fully matured condition, it is represented by merely a fine granular line (Plate XX, fig. 1), but in some species (see *H. austini*, Plate XXIV

^a Paleontologia Indica, 13th Ser., XIII, 1886, pp. 861, 871.

^b Studies on Monticulipora, American Geologist, VI, 1890, p. 118.

fig. 5) its width often equals that of the zoëcium itself. Often the granules or dots are arranged in regular, transverse lines, and give a very pretty appearance in sections. Figures 2, 3, and 4, on Plate XX, show similar intermural structure in *Retepora columnifera* Busk, a chilostomatous bryozoan, and in *Escharopora pavonia* (D'Orbigny) a typical example of the order *Cryptostomata*.

The following tables, showing the geologic and geographic distribution and the specific characters, are here introduced to aid in the identification of the species:

Table of Specific Characters.

Species.	Growth.	Surface of zoarium.	Number of zoecia in 2 mms.	Acanthopores, size, number.	Diaphragms in axial region.	Diaphragms in peripheral region.	Cystiphragms.	Additional features.
<i>H. curvata precipita</i>	Small, ramose.....	Smooth.....	10	Small, numerous.	Moderate number.	Numerous.....	Numerous.....	
<i>H. curvata</i>	Broad, compressed branches	do.....	10	Small, moderate	do.....	do.....	do.....	
<i>H. cinchonidensis</i>	Small, subcylindrical.	do.....	9	Small, numerous.	Absent.....	Moderate number.	Moderate number.	A moderate number of mesopores among maculae and zoecial.
<i>H. diamosa</i>	Small, palmate branches.	Monticulated.....	7-8	Small, few.....	do.....	Few.....	Few.....	Maculae conspicuous.
<i>H. flabellaris</i>	Flabellate.....	Smooth.....	9	do.....	Moderate number.	Numerous.....	Numerous.....	
<i>H. flabellaris spinifera</i>	do.....	Not monticulated	9	Large, numerous.	do.....	do.....	do.....	Surface rough because of very large acanthopores.
<i>H. obliqua</i>	Cylindrical.	More or less tuberculated.	10	Small, moderate	Absent.....	do.....	do.....	
<i>H. grandis</i>	Large, subcylindrical.	Smooth or low monticules.	9	Small, very numerous.	do.....	do.....	do.....	Cystiphragms restricted mainly to bend from axial to peripheral region.
<i>H. pulchra</i>	Large, expanded fronds.	Smooth.....	7-8	Absent.....	Moderate number.	Crowded.....	Crowded.....	
<i>H. bassleri</i>	Small, ramose.....	Tuberculated.....	10	Small, moderate	Absent.....	Absent.....	Moderate number.	
<i>H. libana</i>	Small, thin fronds	Smooth.....	8-9	Small, few.....	do.....	do.....	do.....	Mesopores present among both zoecia and maculae.
<i>H. frondosa</i>	Flabellate.....	Monticulated.....	10	Small, very few.	do.....	Moderate number.	do.....	Monticules, large, rounded.
<i>H. dawsoni</i>	Large, broad fronds.	do.....	8-9	do.....	do.....	Absent.....	Few.....	
<i>H. communis</i>	Large, subcylindrical.	Smooth.....	9	Medium, numerous.	do.....	do.....	do.....	Cystiphragms usually developed only in bend from axial to peripheral region.
<i>H. nodulosa</i>	Ramose, cylindrical.	Small, sharp tubercles.	9	Two sets, numerous.	do.....	do.....	do.....	Two sets of acanthopores. Large and small; numerous tabulated mesopores.
<i>H. richmondensis</i>	Ramose.....	More or less tuberculated.	8	Small, numerous.	do.....	do.....	Moderate number.	Cystiphragms developed in maculae only.
<i>H. austini</i>	Small, cylindrical	Smooth.....	9-10	Medium, numerous.	do.....	do.....	Few.....	
<i>H. wortheni</i>	Ramose, cylindrical.	Sharply tuberculated.	9	do.....	do.....	Moderate number.	Moderate number.	
<i>H. wortheni intercreta</i>	do.....	do.....	9	Small, numerous.	do.....	do.....	do.....	Mesopores abundant; axial walls crinkled.

Table of Specific Characters—Continued.

Species.	Growth.	Surface of zoarium.	Number of zoecia in 2 mms.	Acanthopores, size, number.	Diaphragms in axial region.	Diaphragms in peripheral region.	Cystiphragms.	Additional features.
<i>H. wortheni prasinus</i> ...	Subcompressed branches.	Elongate monticules.	9	Medium, numerous.	Absent	Moderate number.	Moderate number.	Monticules very prominent, elongate.
<i>H. cylindrica</i>	Long, cylindrical.	Smooth to tuberculated.	9	Very large, numerous.	do	Absent	Numerous	Large acanthopores with central tube very narrow and crossed by thin partitions.
<i>H. ramulosa</i>	Large, subcylindrical.	Low, broad monticules.	10-11	Small, few	do	Numerous	do	Cystiphragms in tangential sections, very straight.
<i>H. nicklesi</i>	Subcylindrical, frequently branching.	Smooth	9	Small, very few.	do	do	do	
<i>H. nitida</i>	Small cylindrical stems.	do	10	do	Few	Moderate number.	Moderate number.	Walls of axial region very thin, of peripheral very thick.
<i>H. splendens</i>	Flabellate	Monticulated	7	Wanting	Moderate number.	Numerous	Numerous	Maculae very large and pronounced.
<i>H. gelatinosa</i>	Thin fronds	Smooth	10	Small, few	Few	Moderate number.	Moderate number.	

DESCRIPTIONS OF SPECIES.

HOMOTRYPA CURVATA Ulrich.^a

Homotrypa curvata ULRICH, Jour. Cincinnati Soc. Nat. Hist., V, 1882, p. 242, pl. x, figs. 7-7d.

In growth this species is between the cylindrically ramose species and the truly frondescent forms as *H. flabellaris*. Acanthopores, cystiphragms, and diaphragms are present in a moderate degree. The external characters by which the species may be recognized are the compressed, flattened branches and smooth surface; in thin sections, by the average number of acanthopores (three or four surrounding a zoecium), absence of mesopores except in the maculae, ten zoecia in 2 mm., the presence of diaphragms in the axial region, and of both diaphragms and cystiphragms in the peripheral region.

Occurrence.—A common and characteristic fossil in the Fairmount beds of the Lorraine at Cincinnati, Ohio, and vicinity.

Cat. Nos. 41729-41734, U.S.N.M.

HOMOTRYPA CURVATA var. PRÆCIPTA, new variety.

Plate XXIII, fig. 15.

This varietal name is proposed for the only *Homotrypa* known in the Utica. It has the internal characters of *H. curvata*, but differs in the growth of the zoarium. Its branches are cylindrical, smooth, about 6 mm. in diameter, and divide at short intervals, while the zoarium of *H. curvata* takes the form of broad, compressed branches, dividing at less frequent intervals. Thin sections show that the Utica form generally exhibits more acanthopores, but the number of acanthopores varies slightly in every species.

Occurrence.—Rare in the middle division of the Utica at West Covington, Kentucky. Cumings^b records the same form from the Upper Utica.

Cat. No. 41735, U.S.N.M.

HOMOTRYPA OBLIQUA Ulrich.

Plate XXIII, figs. 12-14.

Homotrypa obliqua ULRICH, Jour. Cincinnati Soc. Nat. Hist., V, 1882, p. 243, pl. x, figs. 6-6b.

This abundant Lorraine species in its internal characters is very much like *H. curvata*. The absence of diaphragms and the slightly crinkled walls in the axial region distinguish it from *H. curvata*.

^aUnder species heretofore described, the reference to the original description only is given. The complete synonymy is presented in Bulletin No. 173, U. S. Geological Survey, 1900.

^bAmerican Geologist, XXIX, 1902, p. 215, footnote.

Externally, however, the two species are readily separated by their different methods of growth, the ramose zoarium of *H. obliqua* with its cylindrical or slightly compressed, more or less tuberculated, branches being quite characteristic. In the Fairmount beds of the Cincinnati area a form of the species with strongly tuberculated, cylindrical branches seldom over 5 or 6 mm. in diameter, occurs very abundantly. The succeeding Bellevue beds also hold the species in abundance, but here the zoarium is more robust and the branches are often subcylindrical and nearly smooth. Specimens 6 cm. or more in length without dividing and 15 mm. in diameter are often found. The prevailing form of zoarium in the Corryville beds is a rather broad, somewhat compressed, tuberculated branch, and specimens of this kind probably led Nicholson to identify *H. dawsoni* at Cincinnati. The internal structure of these various forms of the species is essentially the same. About 10 zoecia in 2 mm.

Occurrence.—An abundant species of the above-mentioned divisions of the Lorraine at many localities in the Cincinnati area. The typical form occurs in the Bellevue beds.

Cat. Nos. 41736–41740, U.S.N.M.

HOMOTRYPA CINCINNATIENSIS, new species.

Plate XXI, figs. 4–10.

Zoarium small, generally less than 3 cm. in height, ramose, dividing rather regularly at short intervals; branches subcylindrical but with a tendency to become frondescent, 2 to 4 mm. thick and 3 to 9 mm. wide. Surface commonly smooth, the clusters of usually larger cells rarely forming low monticules. Zoecial apertures angular, direct, about nine in 2 mm. A moderate number of mesopores present both in the clusters and elsewhere. Acanthopores small, varying in number, sometimes as many as eight or ten surrounding a zoecium. Diaphragms and cystiphagms rather numerous and developed in the peripheral region only.

The shape of the zoarium, the small cells and smooth surface characterize this species. The points of difference from *H. dumosa*, probably its nearest relative, are indicated under the description of that form.

Occurrence.—Common in the Fairmount beds of the Lorraine formation at Cincinnati, Ohio, and vicinity. Apparently the same form occurs at Maysville and McKinneys, Kentucky, at the same horizon.

Cat. Nos. 41742–41746, U.S.N.M.

HOMOTRYPA DUMOSA, new species.

Plate XX, fig. 1; Plate XXI, figs. 1–3.

Zoarium consisting usually of small, inosculating, palmate branches, an average entire colony being 5 cm. high and from 3 to 5 cm. in width;

occasionally larger expanded fronds occur that do not seem to inosculate. Surface with very distinct clusters of large cells, usually raised into low monticules, but sometimes sharp tubercles. Zoœcial apertures angular, direct or nearly so, inclosed by thin walls, seven to eight in 2 mm. Mesopores few, usually restricted to the cell clusters. Acanthopores seldom showing at the surface, but tangential sections reveal a limited number, best developed in the clusters. Zoœcial tubes with walls thin and less crinkled than usual in the axial region and thickened slightly in the peripheral region, where a few diaphragms and rather large cystiphragms are developed.

The characteristic features of this species are its thin walls, comparatively large zoœcia, and conspicuous clusters. *H. cincinnatiensis*, with which this form might be confused, is distinguished by a different mode of growth, smaller zoœcia, less conspicuous clusters, and more abundant mesopores and acanthopores.

Occurrence.—Rather rare in the Fairmount beds of the Lorraine formation at Covington, Kentucky, and Cincinnati, Ohio.

Cat. No. 41741, U.S.N.M.

HOMOTRYPA PULCHRA, new species.

Plate XX, figs. 11-14.

Zoarium large, consisting of expanded fronds, subdividing or sending off other fronds, and ranging from 5 to 10 or more cm. in height; fronds 3 to 5 mm. in thickness and sometimes as much as 8 cm. in width. Surface smooth, the clusters scarcely ever rising above the general surface, but nevertheless conspicuous on account of the large size of their cells. Zoœcial apertures thin walled, angular, direct, seven to eight in 2 mm. An occasional mesopore is developed, but only in the clusters. Acanthopores are apparently always wanting, although the thickenings sometimes seen at the angles of junction simulate these structures. Diaphragms from 1 to $1\frac{1}{2}$ tube diameters apart in the axial region and four or five times as numerous in the peripheral region. Cystiphragms in an increasingly crowded series in the peripheral region and extending close to the surface.

This fine species can be readily distinguished externally by its handsome mode of growth, smooth surface, large and thin-walled zoœcia, and conspicuous clusters; internally, by the absence of acanthopores and the unusual development of diaphragms and cystiphragms, of which the outermost are commonly visible at the surface. It is scarcely necessary to distinguish this from other species. *H. curvata* bears a slight resemblance in growth, but differs in all other features.

Occurrence.—A characteristic and common fossil restricted to the *Platystrophia lynx* horizon of the Mount Auburn beds, Lorraine formation, at Cincinnati and Lebanon, Ohio, and other localities. At Cincinnati this bed occupies the tops of the highest hills.

Cat. Nos. 41747, 41748, U.S.N.M.

HOMOTRYPA GRANDIS, new species.

Plate XX, figs. 7-10.

Zoarium large, 10 cm. or more in height, subcylindrical or compressed, branching rather frequently, an average example being 2 cm. in width and half as much in thickness. Surface generally smooth, but sometimes exhibiting low rounded monticules. Apertures polygonal, direct, thick walled, nine in 2 mm. Mesopores restricted to the maculae. Acanthopores inconspicuous at the surface, but in thin sections they are seen to be small and very numerous, as many as sixteen sometimes surrounding a zoecium. Intermural space finely dotted, the dots often arranged in transverse rows. In tangential sections the polygonal zoecia with their numerous, regularly arranged acanthopores and intermural dots present a very pretty appearance. In vertical sections the zoecial tubes show thin crinkled walls in the axial region, and develop diaphragms only as the peripheral region is approached. In the early part of the latter region, especially in the bend from the axial to the peripheral, numerous cystiphragms and diaphragms are developed, but in the remainder of the long mature region only an occasional cystiphragm is seen, while diaphragms continue as numerous as before.

In the mode of development of diaphragms and cystiphragms this species resembles *Homotrypella*, but otherwise it has the characters of *Homotrypa*. The large subcompressed branches, the numerous, small acanthopores, the intermural structure, and the unusual disposition of diaphragms and cystiphragms are characteristic of the species.

Occurrence.—Abundant in the *Platystrophia lynx* horizon of the Lorraine formation exposed along Lumsleys Fork, 2 miles west of Goodlettsville, Davidson County, Tennessee.

Cat. No. 41764, U.S.N.M.

HOMOTRYPA BASSLERI Nickles.

Homotrypa bassleri NICKLES, Jour. Cincinnati Soc. Nat. Hist., XX, 1902, no. 2, p. 103, figs. 1-5.

The small, cylindrical or slightly flattened tuberculated branches, small zoecia (ten in 2 mm.), and internally the presence of cystiphragms unaccompanied by diaphragms characterize this species.

Occurrence.—A rather common and characteristic fossil of the upper part of the Warren beds, Lorraine formation, at Lebanon and Oregonia, Ohio.

Cat. No. 34330, U.S.N.M.

HOMOTRYPA LIBANA, new species.

Plate XXII, figs. 1-3.

Zoarium, composed of small, thin, flat fronds, the most complete example seen being 5 cm. high, 3 cm. at its greatest width, and less

than 3 mm. in thickness. Surface smooth, with maculae of decidedly larger zoëcia. Apertures thin walled, direct, eight to nine in 2 mm. Acanthopores not observed at the surface. Mesopores of not infrequent occurrence both in the maculae and among the ordinary zoëcia. Internal characters: Diaphragms practically wanting in both regions. Axial region with thin crinkled walls, which are but slightly thickened in the short peripheral zone. A series of generally four cystiphragms is developed in the peripheral region of each zoëcial tube. Acanthopores rather few and inconspicuous, generally situated at the junction angles of the zoëcia.

The smooth, thin, flat fronds will distinguish this neat species from the associated *H. bassleri*. There is no other species sufficiently related to require comparison.

Occurrence.—Not uncommon in the Warren beds of the Lorraine formation at Lebanon, Ohio.

Cat. No. 34329, U.S.N.M.

HOMOTRYPA FRONDOSA, new species.

Homotrypa frondosa (neither *Monticulipora frondosa* D'ORBIGNY nor *Chaetetes frondosus* EDWARDS and HAIME.) CUMINGS, American Geologist, XXIX, 1902, p. 208, pl. x, figs. 11, 12; pl. XI, figs. 2, 5; pl. XII, fig. 1.

In 1850 D'Orbigny proposed *Monticulipora frondosa*,^a based on specimens said to have been found at Cincinnati and Oxford, Ohio. In 1851 Milne-Edwards and Haime redefined and figured the species as *Chaetetes frondosus*,^b basing their description it seems upon the same specimens used by D'Orbigny. Since the internal characters are not described in either case, and as there are several forms of different genera with which *M. frondosa* might be identified, it is probably impossible without the aid of the type specimen to definitely fix upon D'Orbigny's species. The status of the species was further complicated by Nicholson in redefining D'Orbigny's *Monticulipora mammulata*,^c since, as shown later by Ulrich, he really described a species more like *M. frondosa*. Recently Cumings identified D'Orbigny's, or rather Edwards and Haime's, species with a rare form of *Homotrypa*, found in the "very top of the Lorraine or base of the so-called Richmond formation."

An effort to find D'Orbigny's type specimens is now being made, and should this succeed the standing of his species will be adjusted. However, for the present I prefer to adhere to Ulrich's identification of *Monticulipora frondosa*, and Cumings's *Homotrypa frondosa* is here recognized as a new species, preserving that writer's name.

^aProdr. de Pal., I, p. 25.

^bPol. Foss. Ter. Pal., 1851, p. 267, pl. XIX, figs. 5, 5a.

^cQuar. Jour. Geol. Soc. London, 1874, p. 508.

Homotrypa frondosa belongs to the typical group of the genus and should be compared with *H. flabellaris*. The flabellate growth, large rounded monticules, few acanthopores, and the presence of both diaphragms and cystiphragms in the peripheral region are characteristic features.

Occurrence.—Rare in the Warren beds of the Lorraine formation in Indiana and Ohio. Harmans Station, Indiana, is the type locality.

HOMOTRYPA FLABELLARIS Ulrich.

Homotrypa flabellaris ULRICH, Geol. Surv. Illinois, VIII, 1890, p. 411, pl. XXXII, 3-3c.

This species with its varieties has quite a range, both geologically and geographically, specimens being found, generally abundantly, in the Lorraine and Richmond at many localities in the Mississippi Valley. The species was described from specimens found in the Richmond at Wilmington, Illinois. The figured sections illustrating the internal structure were prepared from a colony in which the mature region was not fully developed. Mature specimens show a moderately crowded series of cystiphragms and diaphragms in the peripheral region. If the large acanthopore was omitted from our fig. 14, on Plate XXI, it would show the characters seen in a vertical section of this species. The specific characters are the flabellate growth, smooth surface, nine zoëcia in 2 mm, few small acanthopores, mesopores tabulated, numerous in the maculae and not uncommon among the ordinary zoëcia, a moderate number of diaphragms in the axial region and a well-developed series of diaphragms and cystiphragms in the peripheral region.

Occurrence.—A common species in the Lorraine and Richmond formations of Illinois, Indiana, Ohio, Kentucky, Tennessee, and Wisconsin.

Cat. Nos. 40217-40223 Harris collection, 41772, 41774-41777, 41780-41782, U.S.N.M

HOMOTRYPA FLABELLARIS var. SPINIFERA, new variety.

Plate XXI, figs. 11-15.

This variety agrees with *H. flabellaris* in all essential characters save one, namely, that at rather regular intervals among the zoëcia very large acanthopores are developed, the place of a zoëcium often being occupied by one. This gives the otherwise smooth surface of the zoarium a spiny aspect. The acanthopores often originate in the axial region and proceed to the surface irrespective of the course of the zoëcia.

Occurrence.—Abundant in the Fairmount beds of the Lorraine at Cincinnati, Ohio, and vicinity, and in the Richmond at Richmond, Indiana, Oxford and other localities in Ohio.

Cat. Nos. 41773, 41778, 41779, 41783, U.S.N.M.

HOMOTRYPA DAWSONI (Nicholson).

Plate XXV, figs. 9, 10.

Monticulipora (Heterotrypa) dawsoni NICHOLSON, 1881. Genus *Monticulipora*, p. 141, pl. v, 3-3 f.

With the exception of one feature this fine species was well described and figured by Nicholson. His vertical section (Plate V, fig. 3 e) shows complete diaphragms in the mature region, and in his description he says of that region, "a moderate number of complete horizontal tabulæ being developed;" and again, "tabulæ are in all cases complete and approximately horizontal." The normal condition of the species, as seen in vertical sections, is shown in our figure 9 of Plate XXV. The cystiphragms are here seen to be large and rather irregularly developed or altogether absent, but in the zoecial tubes of the maculæ a full series is usually present. Diaphragm-like structures occur, particularly in the outer part of the peripheral region, but these are probably cystiphragms, which, extending almost across the cell cavity, give in certain sections the appearance of true diaphragms. In the section, figured by Nicholson, apparently all of the cystiphragms presented this appearance. An entire zoarium, with its broad frond and prominent, closely set monticules, is a handsome cabinet specimen.

Occurrence.—A characteristic but rather uncommon fossil of the Lower Richmond in Ohio and Indiana, Waynesville, Ohio, being the type locality. The species has been recorded as coming also from Cincinnati. This is now known to be erroneous, the Lorraine form so identified being a broad, monticulated variety of *H. obliqua*, externally quite similar, but internally very different.

Cat. Nos. 41749-41752. U.S.N.M.

HOMOTRYPA COMMUNIS, new species.

Plate XXIII, figs. 1-4.

Zoarium of subcylindrical or more commonly compressed branches from 5 to 10 cm. high and 4 to 8 mm. in thickness. Surface smooth, with clusters composed of larger cells and mesopores. Apertures direct, polygonal, rather thick-walled, with about nine in 2 mm. Acanthopores seldom seen on the surface, but sections show a zoecium to be surrounded by from four to seven. Walls thin and crinkled in the axial region, much thickened in the peripheral. Diaphragms wanting in both regions. Cystiphragms few, generally restricted to the region transitional to the mature condition.

Externally this species sometimes resembles *H. curvata*, but internally is very different. The only associated form with which it might be confounded is *Bythopora meeki* (James), which often bears a superficial resemblance. Sections show the two species to be very distinct.

Occurrence.—A common fossil in the lower part of the Richmond

formation at Oregonia, Waynesville, Clarksville, Hanover, and other localities in Ohio and at several localities in southeastern Indiana.

Cat. Nos. 40234-40236 Harris collection. 41755, 41756. U.S.N.M.

HOMOTRYPA RICHMONDENSIS, new species.

Plate XXIV, figs. 1-4.

The more or less prominent tubercles, few mesopores, numerous acanthopores, and absence of diaphragms are characteristic of this species. The zoarium consists of ramose, somewhat flattened branches, varying from smooth to slightly tuberculated. Zoecia thin-walled, eight in 2 mm. Acanthopores numerous, small. Mesopores few, as a rule restricted to the clusters. Diaphragms wanting; cystiphragms well developed.

Although resembling several species in one or more details, the combination of characters readily distinguishes this form. For example, specimens of *H. wortheni*, with the tubercles poorly developed, are very similar externally, but internally are distinguished by the presence of diaphragms.

Occurrence.—Not uncommon in the lower and middle divisions of the Richmond formation at Richmond and Versailles, Ind.; and at Hanover, Oxford, and other localities in Ohio.

Cat. Nos. 41784-41787. U.S.N.M.

HOMOTRYPA NODULOSA, new species.

Plate XXIII, figs. 5-11; Plate XXV, fig. 15.

Zoarium ramose, growing from an expanded base attached to other organisms; branches cylindrical or slightly compressed, 2.5 to 6 mm in diameter. Surface with small, well-marked, sharp tubercles, and bristling with large acanthopores. Apertures irregularly polygonal, direct, thin-walled, about nine in 2 mm. At the surface there are two sets of acanthopores, one set very large, perforated, and distributed at rather regular intervals, the other much smaller and more numerous. Tangential sections seldom show the smaller set because of their shortness. Mesopores numerous, though less so when the acanthopores are greatly developed. Walls thin in the axial region and considerably thickened in the peripheral. Cystiphragms sparingly developed and restricted to the early portion of the mature region. Diaphragms wanting in the zoecial tubes, but abundant and much thickened in the mesopores. Vertical sections show that the large acanthopores may arise in the axial region and proceed at various angles to the surface, and are crossed by thin, transverse partitions. The structures supposed to be communication pores are often seen in tangential sections.

This species is particularly interesting because of the unusual development of acanthopores and mesopores. Some specimens, however, exhibit few mesopores at the surface, and these in vertical sections show that as the surface is approached the mesopores close, while tangential sections have a strong development of acanthopores. Other specimens show at the surface few acanthopores and many mesopores, so that some relationship seems to exist in the development of these structures. Externally the acanthopores form the distinguishing character, producing the sharp, knotty tubercles and the spinulose surface. Under a lens the tubercles are seen to be clusters of a few slightly larger cells, scarcely raised above the general surface and bearing one or two large perforated acanthopores at their summits, these acanthopores causing the knotty appearance.

Occurrence.—A common form in the lower part of the Richmond formation at Hanover, Ohio, and less abundant in the middle division at Richmond, Indiana.

Cat. Nos. 40227–8 Harris collection, 41753–4, U.S.N.M.

HOMOTRYPA WORTHENI (James).

Plate XXIV, figs. 10–14.

Monticulipora (Monotrypa) wortheni JAMES, Paleontologist, No. 6, 1882, p. 50; No. 7, 1883, pl. 1, fig. 2.

James's description and figures of *M. wortheni* are scarcely sufficient to recognize the species or even to place the form generically. The following description is based on material identical with specimens of *M. wortheni* in the collections of the U. S. National Museum with Mr. James's label attached.

Zoarium ramose, branches cylindrical, usually about 6 mm. in diameter and dividing frequently and rather regularly. Surface marked with strong, prominent tubercles, usually 2 mm. apart. Apertures polygonal, direct, rather thick walled, about nine in 2 mm. Mesopores in the typical form few, although in the variety described below they are quite numerous. Acanthopores numerous, often inconspicuous at the surface, but blunt when present.

In tangential sections the striking characters are the thick walls, numerous acanthopores, and wide intermural space with its dotted structure. Here also communication pores are well shown. Vertical sections show that the walls in the axial region are thin and rather straight, but become greatly thickened in the peripheral, where a series of cystiphragms larger than usual is developed with a corresponding number of diaphragms.

The sharply tuberculated branches of this fine species readily distinguish it from associated forms. *H. bassleri* is quite similar externally, but the different internal characters, the few acanthopores, and

absence of diaphragms especially, will distinguish it. *H. tuberculata* Ulrich, from the Black River shales of Minnesota, also has a similar zoarium, but in other respects is quite different.

Occurrence.—A very abundant and characteristic fossil of the middle division of the Richmond in Ohio and Indiana. James's specimens were recorded from Lynchburg, Highland County, Ohio. Other localities are Oxford, Waynesville, and Oregonia in Ohio and Richmond, Indiana.

Cat. Nos. 40224, 40226 Harris collection, 41765, 41766, U.S.N.M.

HOMOTRYPA WORTHENI var. **INTERCELLATA**, new variety.

Plate XXIV, fig. 17.

This seems to be a constant and well-marked variety, agreeing with *H. wortheni* in its general zoarial characters, but differing in having the walls more crinkled in the axial region and an abundance of mesopores and small acanthopores in the peripheral. Viewed under a lens, the zoecia at the surface with the numerous mesopores and small acanthopores resemble those of *Homotrypella*, but otherwise the structure is that of *Homotrypa*.

Occurrence.—Abundant in the Richmond near Osgood and near Versailles, Indiana.

Cat. Nos. 41768, 41769, U.S.N.M.

HOMOTRYPA WORTHENI var. **PROMINENS**, new variety.

Plate XXIV, figs. 15, 16.

The very prominent, elongated monticules will distinguish this variety. The zoarium also differs from the cylindrical branches of *H. wortheni* by forming broader, subcompressed to flat fronds. Internally this variety and species are practically identical.

Occurrence.—Abundant in the highest beds of the Richmond along Elkhorn Creek near Richmond, Indiana.

Cat. No. 41767, U.S.N.M.

HOMOTRYPA AUSTINI, new species.

Plate XXIV, figs. 5-9.

The branches of this neat species are small, cylindrical, 4 to 8 mm in diameter, and divide rather frequently. Surface smooth. Zoecia small, polygonal to rounded, thick walled, nine to ten in 2 mm. Acanthopores numerous, four or more often surrounding a zoecium and generally visible at the surface as blunt spines. Mesopores except an occasional one in the maculae, wanting. The zoecia in the axial region are without diaphragms and have thin, crinkled walls, the greatest amount of crinkling occurring just before the periphery.

region is reached. As a rule, both cystiphragms and diaphragms are absent in the peripheral region of the ordinary zoëcia, but in those of the maculæ there is an abundance of the former.

This species is named after its discoverer, Dr. George M. Austin, of Wilmington, Ohio, who, notwithstanding arduous professional duties, finds time for enthusiastically collecting and studying the fossils of that region.

Occurrence.—Abundant in the middle division of the Richmond formation at Dutch Creek, $4\frac{1}{2}$ miles northwest of Wilmington, Ohio, and at Cowans Creek, 7 miles southwest of the same place.

Cat. No. 41762, U.S.N.M.

HOMOTRYPA CYLINDRICA, new species.

Plate XXII, figs. 8-13.

Zoarium ramose, branches long, cylindrical, from 4 to 15 mm. in diameter, dividing dichotomously at intervals of from 3 to 4 cm. Surface varying from smooth to tuberculated, the maculæ or monticules generally somewhat transversely elongated. Zoëcial apertures thick walled, usually angular, direct, about nine in 2 mm. Mesopores few, seldom occurring outside of the clusters. Only well-preserved examples show at the surface the numerous and very large acanthopores characteristic of the species. The walls of the zoëcia in the axial region are thin and but little crenulated, but in the mature region they become so thickened as to almost equal in breadth the diameter of the zoëcial cavity. Cystiphragms well developed. Diaphragms very few, if present at all, the structures simulating them probably being large cystiphragms.

The large and numerous acanthopores and the thickness and minute structure of the walls give a very characteristic, even bizarre, appearance to tangential sections. The number of acanthopores varies, the normal number being four to five when they are large to five to nine smaller ones around a zoëcium. In vertical sections the acanthopores are seen not only to proceed directly to the surface parallel with the zoëcial walls, but they also sometimes cross them obliquely.

Occurrence.—Richmond formation, Richmond and Versailles, Indiana, and Oxford, Ohio.

Cat. Nos. 41757-41759, U.S.N.M.

HOMOTRYPA RAMULOSA, new species.

Plate XXV, figs. 1-4.

Zoarium consisting of subcylindrical or somewhat compressed stems from which branches proceed frequently and without regularity; an average example is 8 cm. high and 8 to 12 mm. in thickness. Surface

with low broad monticules, the center of each usually occupied by a star-like cluster composed of mesopores only and surrounded by cells slightly larger than the average. Apertures polygonal, direct, ten to eleven in 2 mm. Mesopores restricted almost entirely to the clusters. Acanthopores few and rather small, although now and then one of large size may be present, and these in vertical sections have thin transverse partitions. Diaphragms are developed in the zoecial tubes as the peripheral region is approached and are quite numerous near the surface. Cystiphragms of rather small size line the tubes as usual in the peripheral region; in a tangential section they appear much less curved than is generally the case, sometimes showing as a straight line across the cell cavity.

The small cells and much branched growth externally, and the strong development of both diaphragms and cystiphragms in the peripheral region, are characteristics which readily distinguish this form from other Richmond species.

Occurrence.—Middle division of the Richmond formation at Versailles, Indiana.

Cat. No. 41760, U.S.N.M.

HOMOTRYPA NITIDA, new species.

Plate XX, fig. 15; plate XXV, fig. 5-8.

Zoarium of small, frequently branching, more or less cylindrical stems, usually 4 or 5 mm. in diameter. Surface smooth. Macula large, composed of zoecia, which are often twice the diameter of the ordinary cells; 10 zoecia in 2 mm. Diaphragms few in the axial region, not very abundant in the peripheral region, where also the cystiphragms are large but not abundant. Acanthopores small, few, usually wanting.

This species is closely related to *H. gelatinosa*, and may be only a variety of that form. The larger maculae and acanthopores and flabellate growth of the latter are deemed of sufficient value to distinguish it from *H. nitida*.

Occurrence.—Richmond formation, near Osgood, Indiana.

Cat. No. 41771, U.S.N.M.

HOMOTRYPA NICKLESI, new species.

Plate XXII, figs. 4-7.

In growth and external features this species resembles *H. communis* but is readily distinguished by the less robust growth and the tendency to branch more frequently. The internal structure further distinguishes the two, since *H. nicklesi* is of the *H. curvata* group, while *H. communis* is of the group to which it gives its name. Surface smooth with regularly disposed maculae of larger cells and mesopores. Zoecia:

with moderately thick walls, about nine in 2 mm. Acanthopores not present at the surface and usually also absent in sections. Diaphragms absent in the axial region, appearing in the transitional zone to the peripheral region and increasing in number toward the surface. Cystiphragms in a moderately crowded series in the peripheral region. The well-developed diaphragms and cystiphragms and the almost complete absence of acanthopores, together with the growth and surface features, characterize this species. The specific name is in honor of Mr. John M. Nickles, who collected the species.

Occurrence.—Rather abundant in the Richmond at Raywick, Kentucky.

Cat. No. 34328, U.S.N.M.

HOMOTRYPA GELASINOSA Ulrich.

Homotrypa gelasinosa ULRICH, Geol. Surv. Illinois, VIII, 1890, p. 411, pl. xxxii, 2-2d.

The very pronounced elongate maculae characterize this species. In growth and general characters it is near *H. flabellaris*, but the smaller oecia, of which there are ten in 2 mm., few acanthopores and elongate maculae, separate it from that form. The nearest relative is probably *T. nitida*, which see for comparison.

Occurrence.—Rare in the Richmond, at Wilmington, Illinois.

Cat. No. 41770, U.S.N.M.

HOMOTRYPA SPLENDENS, new species.

Plate XXV, figs. 11-14.

Zoarium flabellate, an average example measuring 4 to 5 cm. in height, 3 to 4 cm. in width, and 3 to 4 mm. in thickness. Surface with strongly elevated monticules, 2.5 to 3 mm. apart, measuring from center to center. Apertures varying from subpolygonal to sub-circular, with very thick walls, about seven in 2 mm. Acanthopores apparently wanting. In the axial region the walls are very thin and the diaphragms rather numerous, averaging a little more than their diameter apart. In the peripheral region the walls are very much thickened and both cystiphragms and diaphragms are abundant.

This splendid species, with its large cells and thick walls, requires no detailed comparison with other forms. The associated *H. flabellaris* resembles it in zoarial growth, but the difference in the size of the cells of the two species can be seen with the unassisted eye. Sections show that a great deal of calcareous tissue is deposited along the tube walls and even on the cystiphragms. This accumulation often obscures the cystiphragms and the boundaries of the cells. The unusual thinness of the walls in the axial region is in marked contrast with their great thickening in the peripheral region. The apparent absence of

acanthopores in this well-developed species of *Homotrypa* is also noteworthy.

Occurrence.—Not uncommon in the Richmond formation at Wilmington, Illinois.

Cat. No. 41761, U.S.N.M.

EXPLANATION OF PLATES.

PLATE XX.

Homotrypa dumosa, new species, p. 576. (See also Plate XXI, figs. 1-3.)

- Fig. 1. Tangential section $\times 35$, showing the thin walls, small acanthopores, and narrow intermural space.
Lorraine formation, Covington, Kentucky.

Retepora columnifera Busk, p. 571.

2. Tangential section of this recent chlostomatous bryozoan, showing structure of walls and parenchymal chord.

Escharopora pavonia (D'Orbigny), p. 571.

3. Vertical section $\times 35$.
4. Tangential section $\times 35$.
Lorraine formation, Cincinnati, Ohio.

Ceriocava ramosa D'Orbigny, p. 569.

- 5, 6. Vertical and tangential sections of this cyclostomatous bryozoan, showing vesicles supposed to be homologous with the cystiphragms. (After Ulrich. Cretaceous of France.)

Homotrypa grandis, new species, p. 578.

7. Tangential section $\times 20$.
8. Vertical section $\times 20$, showing only a portion of the axial and peripheral regions.
9. Tangential section $\times 50$ of a single zoecium.
10. Natural-size view of a fragment of a zoarium.
Lorraine formation, Lumsleys Fork, 2 miles west of Goodlettsville, Davidson County, Tennessee.

Homotrypa pulchra, new species, p. 577.

11. Vertical section $\times 20$, showing the distribution of diaphragms and cystiphragms.
12, 13. Tangential section $\times 20$, and a small portion of same $\times 50$.
14. A small but nearly complete zoarium, natural size.
Lorraine formation, Cincinnati, Ohio.

Homotrypa nitida, new species, p. 586. (See also Plate XXV, figs. 5-8.)

15. Tangential section of several zoecia $\times 40$.
Richmond formation, near Osgood, Indiana.

PLATE XXI.

Homotrypa dumosa, new species, p. 576. (See also Plate XX, fig. 1.)

- Fig. 1. Fully matured region of a tangential section $\times 20$.
 2. Vertical section $\times 20$.
 3. A complete zoarium, natural size.
 Lorraine formation, Covington, Kentucky.

Homotrypa cincinnatiensis, new species, p. 576.

- 4-6. Three nearly complete zoaria, natural size, exhibiting variations in growth.
 7, 8. Tangential and vertical sections $\times 20$.
 9, 10. Tangential sections $\times 50$ of zoecia in the peripheral region in different stages of maturity.
 Lorraine formation, Cincinnati, Ohio.

Homotrypa flabellaris var. *spinifera*, new variety, p. 580.

11. Portion of a frond, natural size.
 12, 13. Nearly complete zoaria, natural size, of a narrow form of the variety.
 14, 15. Vertical and tangential sections $\times 20$.
 Lorraine formation, Covington, Kentucky.

PLATE XXII.

Homotrypa libana, new species, p. 578.

- Fig. 1. Vertical section $\times 20$.
 2. Tangential section $\times 20$.
 3. Tangential section of several zoecia $\times 40$, showing the intermural structure and the small acanthopores.
 Lorraine formation, Lebanon, Ohio.

Homotrypa nicklesi, new species, p. 586.

- 4, 5. Vertical and tangential sections $\times 20$.
 6. Tangential section of several zoecia $\times 40$.
 7. Natural-size view of a fragment of a zoarium.
 Richmond formation, Raywick, Kentucky.

Homotrypa cylindrica, new species, p. 585.

- 8, 9. Tangential and vertical sections $\times 20$, illustrating the internal characters of the species.
 10. Tangential section of several zoecia $\times 40$, showing the intermural structure and the large acanthopores with the small central tube.
 11. Vertical section $\times 50$, exhibiting structure of walls and cystiphragms.
 12, 13. Natural-size views of two nearly complete zoaria.
 Richmond formation, Richmond, Indiana.

PLATE XXIII.

Homotrypa communis, new species, p. 581.

- Figs. 1, 2. Tangential and vertical sections $\times 20$.
 3. Tangential section of a single zoecium $\times 50$, showing the characters in the fully matured region.
 4. Natural size view of a small zoarium.
 Richmond formation, Oregonia, Ohio.

Homotrypa nodulosa, new species, p. 582. (See also Plate XXV, fig. 15.)

- Figs. 5, 6. Vertical sections $\times 20$ and $\times 30$, illustrating the internal characters.
 7. Tangential section $\times 20$, showing large acanthopores and few mesopores.
 8. Tangential section $\times 20$, with numerous mesopores.
 9-11. Three fragments, natural size.
 Richmond formation, Hanover, Ohio.

Homotrypa obliqua Ulrich, p. 575.

12. Vertical section $\times 20$.
 13. Natural size view of a complete zoarium of the form found in the Fairmount beds.
 14. Natural size view of the prevailing form in the Bellevue beds.
 Lorraine formation, Cincinnati, Ohio.

Homotrypa curvata var. *praeipta*, new variety, p. 575.

15. Fragment of zoarium, natural size. Utica formation, West Covington, Kentucky.

PLATE XXIV.

Homotrypa richmondensis, new species, p. 582.

- Fig. 1. Tangential section $\times 20$, through the fully matured region.
 2. Vertical section $\times 20$.
 3. Tangential section $\times 50$, illustrating the structure of the walls and acanthopores.
 Richmond formation, Hanover, Ohio.
 4. Specimen of the natural size.
 Richmond formation, Richmond, Indiana.

Homotrypa austini, new species, p. 584.

5. Tangential section $\times 20$, showing the wide intermural spaces.
 6. Vertical section $\times 20$, illustrating the distribution of the cystiphragms.
 7. Fully matured condition of a single zoecium $\times 50$.
 8, 9. Fragments of zoarium, natural size.
 Richmond formation, Dutch Creek, near Wilmington, Ohio.

Homotrypa wortheni (James), p. 583.

10. Vertical section $\times 20$.
 11, 12. Tangential sections $\times 50$ and $\times 20$, illustrating the characters of the mature region, the latter showing communication pores.
 13, 14. Fragments of zoaria, natural size, showing variations in size and surface characters.
 Richmond formation, Richmond, Indiana.

Homotrypa wortheni var. *prominens*, new variety, p. 584.

- 15, 16. Natural size views of two fragments. Richmond formation, Elkho Creek near Richmond, Indiana.

Homotrypa wortheni var. *intercellata*, new variety, p. 584.

17. Tangential section $\times 35$, through mature region. Richmond formation near Osgood, Indiana.

PLATE XXV.

Homotrypa ramulosa, new species, p. 585.

- Figs. 1, 2. Vertical and tangential sections $\times 20$, illustrating the internal characters.
3. Tangential section $\times 50$, through fully matured region of several zoecia.
4. Natural size view of a nearly complete zoarium.
Richmond formation, Versailles, Indiana.

Homotrypa nitida, new species, p. 586. (See also Plate XX, fig. 15.)

5. Tangential section $\times 20$.
6. Vertical section $\times 20$, showing form and distribution of cystiphragms and diaphragms.
7, 8. Natural size views of fragments.
Richmond formation, near Osgood, Indiana.

Homotrypa dawsoni (Nicholson), p. 581.

9. Vertical section $\times 20$, showing distribution of cystiphragms.
10. Tangential section $\times 20$, through fully matured region.
Richmond formation, Waynesville, Ohio.

Homotrypa splendens, new species, p. 587.

- 11, 12. Vertical and tangential sections $\times 20$, illustrating the internal characters of the species.
13. A single zoecium $\times 50$, as seen in tangential section.
14. Natural size view of a fragment of a frond of this species.
Richmond formation, Wilmington, Illinois.

Homotrypa nodulosa, new species, p. 582. (See also Plate XXIII, figs. 5-11.)

15. Tangential section of a single zoecium $\times 35$, showing communication pores. Richmond formation, Hanover, Ohio.